Progress Report
NOS Tide Gauge Network

Tide Station Operation

Period of Activity: 01 October 2022 – 30 September 2023

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Budget Summary
FY 2023: $100.1K

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1. Project Summary

The National Oceanic and Atmospheric Administration (NOAA) Center for Operational Oceanographic Products and Services (CO-OPS) operates and maintains the National Water Level Observation Network (NWLON) consisting of 210 long-term, continuously operating water level stations on all U.S. coasts, territories and in the Great Lakes. The operation of these stations, and their long period of record, is critical to understanding sea level rise and climate variability, both on a global and local scale. Tide gauge records provide relative sea level trends critical for coastal zone management, engineering, and long-term planning and decision-making on a local and national scale. They also provide calibration for satellite altimeters to better understand and measure global sea level changes caused by thermal expansion and changes in freshwater input. While the period of record for satellite altimeters is relatively short, tide gauge records exist for several decades, giving us a better understanding of what changes we have seen, and how that reflects future variability in sea level due to climate change. In the climate community, users of this data include climate researchers, NOAA and federal partners who use the information to develop climate mitigation strategies for coastal communities or for management decisions, coastal managers responsible for implementing climate change response and mitigation strategies, and the public who require local information to downscale global models information and develop local projections. All CO-OPS data are available real-time, and

products, including long-term trends and monthly and annual means, are available through the CO-OPS Tides and Currents website, and are archived at all three Global Sea Level Observing System (GLOSS) archive centers. The data are also available through the Permanent Service for Mean Sea Level. Twenty-seven NWLON stations currently comprise the U.S. contribution to the GLOSS Core Network, and forty-five are part of the GLOSS-Long Term Trend (LTT) network. CO-OPS also supports the Global Earth Observation System of Systems (GEOSS) by providing on-line sea level trends and analysis for 114 international GLOSS-LTT stations (using internal funding), by operating and maintaining the GLOSS-ALT tide gauges at Oil Platform Harvest for satellite altimeter calibration and evaluation and by maintaining the long-term tide station in Bermuda as part of the GLOSS Core Network

2. Scientific and Observing System Accomplishments

Performance measures from the FY 2023 Work Plan.

2023 Performance Measures	
Performance Measure	**2023 Level**
GNSS Data Availability To SONEL	100%
Number of GNSS stations with data sent to Data Assembly Centers (DAC)	6

Notable observing achievements during FY 2023
During FY23, CO-OPS continued to expand and improve its network of GNSS receivers at NWLON GLOSS stations. A receiver was installed at the La Jolla, CA station (ID# 9410230) in late August and after a short evaluation period was made available to NOAA National Geodetic Survey and SONEL. The data and metadata can be accessed via this link: https://www.sonel.org/?page=gps&idStation=4686. This brings the total number CO-OPS installed GNSS stations funded through GOMO up to six.

Additional GNSS related activities included routine O&M and oversight of the operational stations which as the system grows, consumes more resources, both human and financial. In May, a field recon was conducted at the Atlantic City, NJ NWLON station (ID #8534720) to ascertain if a GNSS receiver could be installed at this location. The NWLON station is located on a pier which also contains an amusement park and a helipad. Both of these items create problems for collecting high quality GNSS data. The recon confirmed these obstacles and we started to look at identifying alternate locations. Finally, work was completed on developing methods to ensure the quality of the GNSS antenna mounting. Before the antenna reference point can be tied to the water level sensor the monument it is affixed to needs to be made level within ±1°. The CO-OPS Engineering Division designed and created a highly accurate bubble level mount that is temporarily screwed to the monument and it has been found to be the most reliable way

of ensuring the monument and thus the antenna would be within the level tolerance limits. Pictures of the custom-made mount can be found in the attached slide.

Significant progress was made in returning the Bermuda GLOSS water level (ID# 2695540) station to operational status during the year. The station failed in November 2019 and a repair trip could not be organized before pandemic travel restrictions were implemented in March, 2020. Attempts to repair the station using on site contacts were not successful. When the field crew arrived in Bermuda in June, all the station electronics were replaced, the water level was releveled and the station made operational. The station has been working since the repair. This work was funded using CO-OPS base funds as part of our support for GLOSS.

Near the end of 2023, a field crew was able to fly to the Platform Harvest station (ID# 9411406) and removed the water level station hardware, thus completing the deactivation of the station. Power to the station was cut off more than a year ago in connection to the deactivation of the platform. During the year, the University of Hawaii Sea Level Center (UHSLC) installed a station at Vandenberg AFB which serves as a replacement for Platform Harvest. CO-OPS reached out to both NASA JPL and UHSLC to provide any support needed for this transition and ongoing operations.

CO-OPS' website is: https://tidesandcurrents.noaa.gov/

3. Outreach and Education

Though out the year, CO-OPS worked with the international GNSS observing community, specifically, NOAA/NGS, SONEL and the University of Nevada Geodetics Lab to ensure that CO-OPS data sets meet international requirements and delivered to the various data centers in a timely manner (GNSS data is available to the data centers less than 24 hours of CO-OPS collection). Many meetings were held with NGS to coordinate roles and responsibilities for GNSS observations, data management, along with vertical land movement and positioning product development. These talks are ongoing and will ensure that future activities are conducted efficiently and produce the highest data possible.

CO-OPS attended the first GLOSS meeting since the pandemic in November, 2022 and provided updates on GLOSS water level and GNSS activities.

4. Publications and Reports

CO-OPS did not produce any publications using GOMO funded work in FY23.

4.1. Other Relevant Publications

In 2023 work started on a CO-OPS technical report tentatively titled 'Exploratory Data Analysis - Use of GNSS for Monitoring Water Level Sensor Vertical Stability'. Lead author is Robert Heitsenrather of CO-OPS' Engineering Division. This report is planned for publication in late 2024.

5. Data and Publication Sharing

CO-OPS continued to ensure that its GNSS data was widely available to stakeholders and the international climate research community. As noted above, GNSS data from all six stations is available through SONEL's and NOAA/NGS websites. Information on the leveling tie to the nearby GLOSS water level station is also available on these sites and through contact with CO-OPS. Data from the six stations is also being ingested in near real time by the University of Nevada Geodetic Lab and displayed on their website (http://geodesy.unr.edu/NGLStationPages/gpsnetmap/GPSNetMap.html). Since NGS is part of the US Government, and maintains their own GNSS observing system they handle all data management and stewardship for CO-OPS data.

6. Project Highlight Slides

The attached slides show the installation of the La Jolla, CA cGNSS station in August, 2023 and the new level kits constructed by CO-OPS.